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Center Line is published every other manth in the interest of the management, employees ond others dedicated to the Mantana highwoy program. It is designed to present informatian an highway construction, pragress, people and ploces.

FRONT COVER

The Montona Highwoy Department building in Heleno is pictured on aur front ond back covers in an unusual ortistic form. This high-contrast photo is the product of o lab process dane in the Helena headquarters photo deportment. Marv Kolland, highway photographer, took the original photograph at narmal exposure, but thraugh o special treotment of the negative he created this unusual ond dromatic black-and-white effect. The finished picture often resembles an ink sketch, ond in this particulor photograph, the many symmetricol windows of the Scott Hort building form on interesting illusion. For the full effect, open the mogozine ond view both covers ot once.

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Helena, Montana 59601

LIKE A BULLDOZER, the nation's highway industry has ripped its way from a $7.4-billion-a-year business in 1955 to a $14.2-billion-a-year business today. More than 40,000 construction companies, cement companies, steel companies and manufacturers of machinery are now engaged in building and repairing highways and in turning out the raw materials and equipment to build and repair them. They employ 870,000 workers, including 370,000 construction workers alone.

Maintaining and policing the highways keeps another 568,000 workers employed; and nobody can begin to estimate how many hundreds of thousands of auto workers, gas station attendants, short-order cooks, waitresses, sign painters and the like depend on the highway industry for their livelihood. Men have made fortunes in farm land because the state decided to build a highway through it. Other men have lost fortunes on downtown real estate because a highway diverted traffic from it.

The mighty auto industry depends heavily on the highway industry. Its phenomenal growth during the past decade got a good push from the 41,000-mile Interstate Highway Program. This program has poured $23 billion into highway construction since 1956, with the Federal Government putting up $9 for every dollar contributed by the states. It will pour in another $26 billion-to-$30 billion by 1973. Under the present schedule, the program will then be completed.

What will happen after that to the hundreds of thousands of workers, the multitude of businesses that depend on highway buildings?

At the Crossroads

Another interstate highway program? Absolutely not. That can be said with certainty. President Lyndon Baines Johnson is dead set against the idea and so are the men around him. Alan S. Boyd, Under Secretary of Commerce for Transportation and Johnson's chief planner for a national transportation policy, says, "We aren't going to pave the United States."

Will the highway industry then shrink back to a $7.4-billion-a-year business? Again, the question can be answered with certainty. Absolutely not. It will continue to grow. Not all the contractors, manufacturers and workers now prospering from the industry will continue to prosper, because it will grow in a different way. As Edward H. ("Ted") Holmes, director of planning for the Bureau of Public Roads, puts it, "There will be a lot of changes and some people will get hurt." Holmes is quick to add however, "Many will benefit."

The Interstate Highway Program has created the necessity for another program. It has made getting from city to city by auto or truck increasingly easy, but, in doing so, it has created maddening traffic problems for the cities and the suburbs around them. By 1972, says Holmes, the great need will be for "secondary roads, city streets, county roads, special roads linking the suburbs, and beltways. Beltways will probably be installed around every urban area, like Boston's Route 128."

President Johnson and his transportation advisers do not believe the Federal Government should continue to put up $9 for every $1 the states contribute. "The ratio could drop as low as $2 for $1 or lower," says Holmes. However, the Johnson Administration already is thinking of ways to make

Montana interstate cuts through numerous types of terrain. Here Interstate 15, north of Helena, extends through rolling green hills and mountains. Montana's share of the interstate system surpasses 1,180 miles.

Reprinted by permission from Forbes Magazine

it easier for the states to raise the money.

Says Charles L. Schultze, director of the Bureau of the Budget, "We've built up a huge industry. We can't just pull the rug out from under it."

One idea, which is gaining increasing support within the Administration, would be to let the states collect at least part of the federal gasoline and other "user" taxes. The federal gasoline tax was increased to help finance the Interstate Highway Program. A good portion of the tax might stay on the books after the program is completed. The present sentiment within the Administration is for basing the amount of the users' tax which the states get on the amount of traffic their highways carry. This could be determined by the gas and diesel fuel consumed in the states.

An off-beat suggestion which has been kicked around in the Administration involves setting up computers at highway checkpoints, which could read license plates. Such computers already have been devised. New York City recently demonstrated how one could catch a motorist who had failed to appear in court to pay a traffic fine. With the computers, it would be possible to bill autoists and truckers for using the highways, much as they are billed now for using electricity.

"Highway taxes are relatively easy and painless to collect," says Stanley S. Surrey, Assistant Secretary of the Treasury for Tax Policy. "People have gotten used to them."

Impact on Autos

For the auto industry, the determination of the Johnson Administration to emphasize road building within urban areas rather than between cities is tremendously important. How well the industry adapts to the changes will determine whether it can maintain its terrific pace. At the moment there are indications that much of the industry favors the status quo on highways and on mass transportation. After all, things couldn't be better; why not keep them this way?

Mammauth interchanges cut thraugh farm cauntry in Mantana, and this diamand-shaped interchange is an Interstate 90 at Manhattan. The ground is still cavered with a layer af winter snaw.

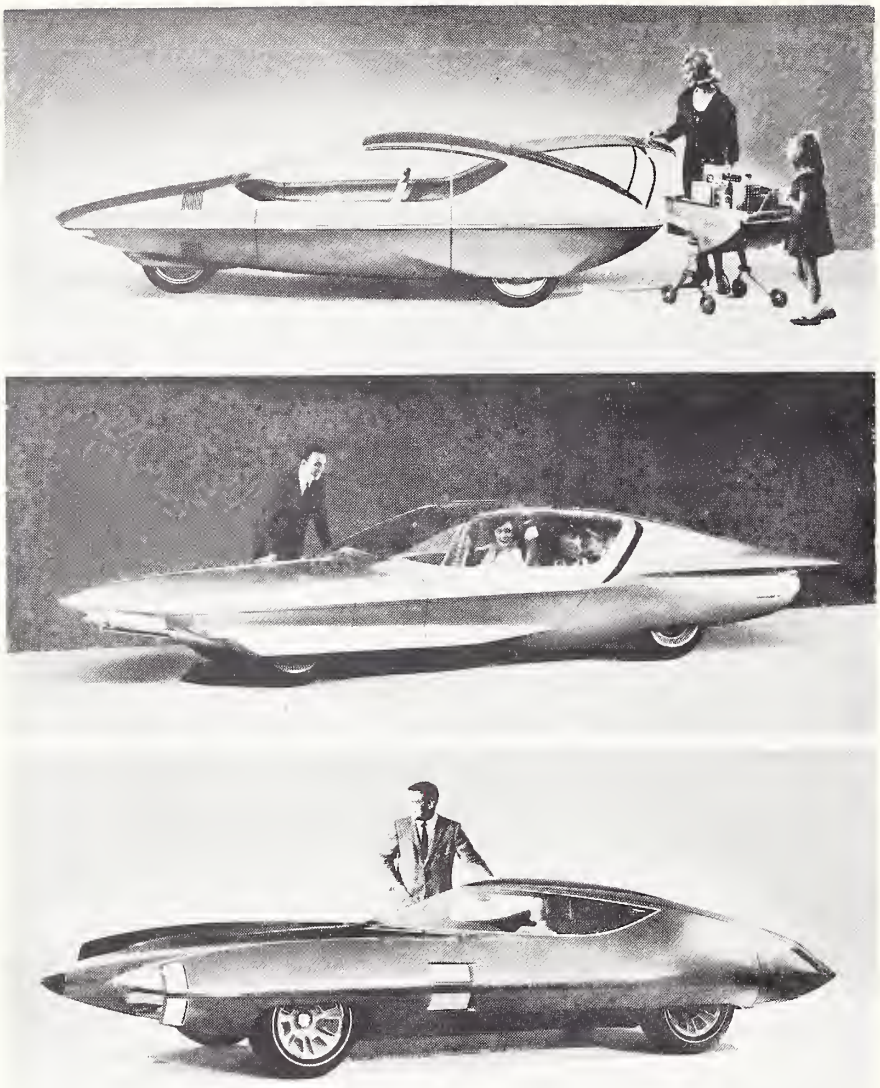
But wiser heads probably will prevail. The auto industry was itself born of changes in society, in geography and in technology. However pleasant the present situation is for Detroit, the bright men who run the industry will certainly realize it cannot continue forever.

Thus the changes looming in highway building offer both a challenge that seems to be in the best position to go with the changing tides is, not surprisingly, General Motors. As manufacturer of more than 80% of the nation's buses, GM is in a great position to profit from any shift toward mass transit. As manufacturer of something like 65% of the nation's diesel locomotives, it will share in any revival of the railroads.

But, like the others, GM will have to adapt to basic changes in the auto business—which, after all, is nearly 60% of its business.

Several of President Johnson's transportation advisers believe the auto manufacturers may some day be forced to develop electrically operated cars. They say the exhaust fumes from gasoline-operated cars are becoming unbearable as congestion in the urban areas increases. The automakers themselves believe they have the problem of exhaust fumes licked. California now has a law requiring that all new cars sold in the state be engineered to cut down the fumes. General Motors, Ford and Chrysler all say they have done so. On GM and Ford cars, it will increase the price by about $50; on Chrysler's, by about $25. Universal Oil Products has developed a catalytic

(Continued)



General Motors presents a unique preview of tomorrow's automotive world with these three experimental idea cars with a host of far-advanced features. Each of the three cars is highly specialized, designed for a particular motoring purpose. The Runabout (top) has a built-in shopping cart system and runs on three wheels, so it will have excellent maneuverability. The Firebird IV (center) has television, stereo, a game table and refrigerator for the family to enjoy while it operates automatically on an electronic guidance system. The GM-X (bottom) has a maximum of controls and instrumentation for the enthusiast who wants a highly personal driving experience. Some of the new ideas incorporated here may not be used in production cars for quite a few years, but present-day engineering research has proven every one of them to be definitely possible.

muffler that cuts down the fumes of any car.

Chrysler, however, does not rule out the possibility of electrically operated cars. Such cars are not practical now. They are inefficient and expensive. However, says George J. Huebner, Jr., director of research for Chrysler, the fuel cell that provided the electric power for Gemini V could theoretically be adapted to autos. He believes it will take years of research and development, possibly 15 years, to put the first experimental car on the road, another 10 for development to a point where the car might be considered for production. But, he says, it's possible.

GM is thinking in terms of automatically operated cars. It already has successfully tested a system to control a car by electronic devices built under a road or beside it. This system can steer, brake and accelera cars on the road and contro the spacing between them. Under GM's plan, major roads would have special "Autolines." Once a driver entered an Autoline, the electrohydraulic system in his car would operate it for him. The advantage of the system is, first of all, safety, but it also permits cars to run more closely together. Roads, therefore, will be able to carry more traffic.

All the auto manufacturers are working on cars with adjustable steering ratios. In city traffic, a driver needs a car that responds quickly to a twist of the wheel—to park, for example. On highways, he's safer with a more sluggish response. GM is developing cars that will automatically adjust the steering ratio. The faster the auto goes, the more sluggish the response will be.

Ford is working on a car with an adjustable suspension system, enabling a driver to use different systems depending on what kind of road he's traveling on. (Mustang 1, the experimental forerunner of the present Mustang, had it.)

The manufacturers also are preparing for an increasing demand for specialized cars. GM Vice President William L. Mitchell points to his company's display of experimental cars at the New York World's Fair to indicate what the future may bring. Among them is a utility vehicle for commuting and shopping that gets high mobility from having only three wheels. Another is Firebird IV, a big cross-country vehicle with refrigerator, TV, game table and individual reading lights. Firebird IV can be operated a tomatically by the electrohy-

draulic devices that GM has developed.

At Ford, chief stylist Don De LaRossa envisions a car designed especially for shopping. It's a rear-loading car that seats three in front.

Suppose the government experts are right in believing that electrically operated cars will someday replace gasoline-operated cars in congested areas. How will that affect the gas and oil industry? One of the experts, Robert F. Baker, director of research at the Bureau of Public Roads, says that it won't hurt them in the least. The gas and oil companies, he says, "will eventually find that a barrel of oil will have more value as raw material for chemical products than it will as fuel. It will be a waste to burn oil products as fuel."

A top official at Standard Oil of New Jersey agrees. He says: "We are not worried about this thing. By the time electric cars are practical, we will be making hundreds of other products. That's how fast our petrochemical business is growing. It's no trick to expand a refinery right into the petrochemical business."

Small oil companies do not take as confident a view of the situation as Jersey Standard. Their attitude is that electrically operated cars aren't worth even thinking about because it will be 50 years before they become practical. Says Dr. William J. Sweeney, chemical engineering consultant for the American Petroleum Institute, "Electrical fuel cells in vehicles? That's just a lot of wishful thinking."

Opposition Certain

No doubt the Administra-

(Continued)

Yesterday, Today and Tomorrow

There are now 3.6 million miles of roads and streets in the United States—about one mile for every square mile in the country. And they hum with 75 million cars and 15 million buses and trucks. More than 100 million Americans are licensed to drive. This year, they are expected to drive about 870 billion miles.

In 1912 the federal highway-building program was born when Congress voted to give the states $500,000 to improve postal routes.

1916: Congress passed the Federal Road Act. The appropriation was modest—$5 million for the entire U. S. for the year 1917—but the principles Congress laid down were the $47-billion Interstate Highway Program. The states were to select the projects and build them, subject to review by the Bureau of Public Roads, they were to supplement the federal appropriation and the roads were to remain their property.

1921-32: Federal highway-building funds amounted to less than $90 million a year. They were used mostly to help finance the paving of existing dirt and gravel roads.

1933-41: By now the Federal Government was contributing about $200 million a year toward building roads. This figure did not include the amount it was spending on make-work WPA projects.

1944: Anticipating the end of the war, Congress authorized a three-year highway program, including the Interstate Highway Program.

1946: Federal spending for highways reached $500 million a year.

1956: As the annual spending figure reached $700 million, Congress voted to expand the program, with particular emphasis on interstate highways. The eventual cost of the Interstate Highway Program was estimated at $27 billion.

1961: The estimate was revised upward to $41 billion.

1962: For the first time, Congress recognized the problems that interstate highways were creating for the cities into which they poured automobiles. In the Act of 1962, Congress decreed that federal funds could not be approved for highway projects in urban areas unless the projects were part of a comprehensive program that took into account the needs of those areas.

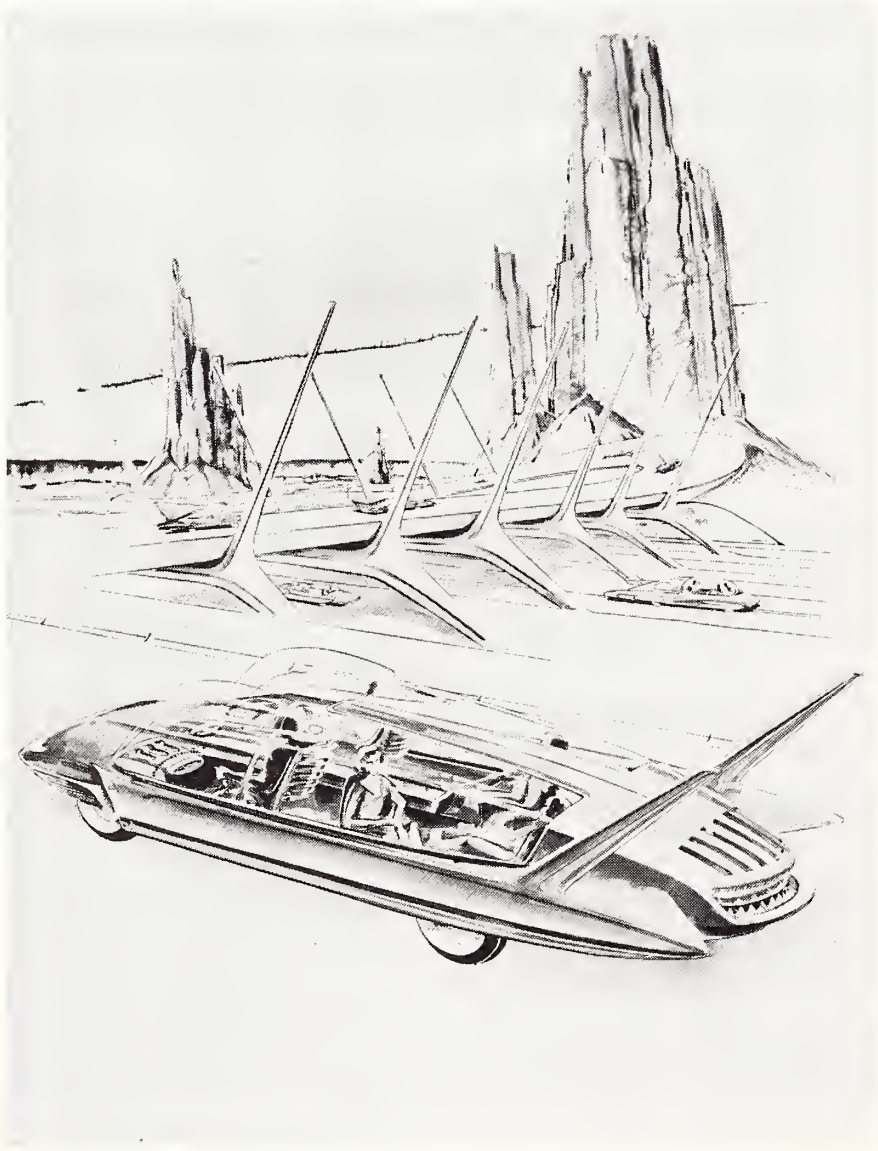
1965: Estimates of the cost of the Interstate Highway Program rose to $46.8 billion.

According to government statisticians, by 1970 there will be 103.7 million vehicles on the road and 127.2 million by 1980. Government experts do not believe this will create a need for many more miles of city-to-city highways. The problem will be to improve existing highways and make it easier to drive in urban areas.—END

tion's determination to cut down on building interstate highways after the Interstate Highway Program will meet resistance. The auto and gasoline companies are reluctant to face the prospects of far-reaching changes. Most of the powerful state highway commissions naturally are in favor of building more and more state highways forever and forever, because it gives them so many billions of federal dollars to play around with.

The American Association of State Highway Officials already is working on a study of what it believes will be needed after 1972. Commenting on this, Transportation Chief Boyd says: "If the study will be just a compilation of what the highway departments think they need to keep roadbuilders busy, we'll junk it."

An indication of the kind of pressure the Administration will have to face came in 1965 at the annual Southern Governors Conference in Sea Island, Ga. The governors called on the Federal Government to increase spending on highways by $1 billion a year. At the same time, however, President Johnson showed how tough he can be under pressure when a pet idea of his is concerned by refusing to accept the emasculation of his program to beautify the highways.



Preparing for the future—both near and distant—seems to be the mission to which automotive designers are dedicated. Advanced stylists at Ford Motor Company have really let their imaginations take them into the future, free from restrictions of what seems possible today. Here they envision motorists traveling from coast to coast on highways perhaps as wide as half a mile. In this particular car of the future, passengers would enjoy the comforts of club-car seating, and the driver would be able to join them, since his vehicle would be controlled electronically.

Outlook for Contractors

As Ted Holmes says, when the Government shifts from promoting the construction of interstate highways to concentrating on urban and suburban traffic problems, "some people will get hurt."

About 25,000 contractors and subcontractors are now working on the highway program. Some of them are major corporations. Peter Kiewit Sons, Inc., of Omaha, Neb., for example, has so far gotten $382.1 million in Interstate Highway Program contracts; S. J. Groves & Sons Co. of Minneapolis, $178.9 million; Guy F. Atkinson Co., a west coast firm, $162.4 million. With so many construction companies in the business, however, the overwhelming majority get contracts for $50,000 or even less. Says Federal Highway Administrator Rex M. Whitton: "The average interstate contractor is a father-son team, a small outfit scrambling for business in a highly competitive field."

By and large, it's these small contractors who could take a beating after 1972, because building interstate highways is a relatively simple job compared with building the street, bridge, and especially tunnel facilities needed to handle urban and suburban traffic. Says Edward J. Rainey, vice president of giant S. J. Groves: "In the cities and suburbs, costs triple. You have to have underground work."

Rainey adds: "When you get into the city, you get into trouble. Union labor is more difficult, politics are harder to figure and public opinion has you right in its sights."

These problems will drive many of the smaller contractors from working on transportation jobs. They do not awe the big contractors, however; the big contractors are even prepared to shift from highway jobs to building mass-transit facilities. They have the organization to handle any kind of construction work.

A host of companies will profit from the switch from interstate highway construction to solving urban and suburban traffic problems. Among them is Minnesota Mining & Manufacturing, which not only is the biggest supplier of highway signs but has also developed reflective materials that competing suppliers must buy. Transportation experts say that city tunnels will require more signs and more reflective materials than interstate highways.

Eventually, the emphasis on urban and suburban traffic will also put money in the tills of electronic manufacturers. It will be a great market for computers. Bureau of Public Roads Research Director Barker foresees the day when urban and suburban traffic will be electronically controlled. Detroit, he points out, already has a pilot system of controls. On the John C. Lodge Freeway, electronic eyes watch the flow of traffic and close entrance ramps when a jam-up occurs. They feed the cars into other entrance ramps which are not so congested.

A study made for Detroit by Michigan State University showed that use of the electric eyes has cut down stoppages of the Lodge Freeway by 90%. It also increased the average auto speed, during times of traffic congestion, from about 27 miles to 37 miles an hour.

Chicago has installed an electronic control system for the Congress Expressway. Toronto has one that is able to control 1,000 intersections from a central Univac 1107 computer. New York City is planning to spend $100 million on electronic traffic controls. Sperry Rand was the low bidder ($5.4 million) for the first unit in the system.

International Business Machines is putting in a computer system for San Jose, Calif. San Jose now has 30 intersections under computer control. By the end of the year, it will have 60 sections under control. "Every city over 50,000 in population is a ripe market now for computer traffic controls," says Ozzie I. Bermant, program manager for traffic control studies at IBM's Data Processing division.

"These systems will help a lot," says Baker, "but they're just the first step in the controls needed. Next we are going to

This city of tomorrow—a glittering complex of commerce and urban living—took shape in the General Motors Futurama ride at the New York World's Fair. Utilization of air rights over existing thoroughfares for commercial and residential structures is one of the features of the futuristic city as foreseen by GM Styling Staff members. Air space over metropolitan roadways is empty today, but in the future it will be used to increase the available building area without expanding the city limits. Here an urban residential area complete with parks and shopping centers stands above a multi-lane highway.

have to communicate directly with the driver through induction type radios, signal or voice, right into his car. At the push of a button, the driver will be able to tell which way to go for minimum traffic density."

Bus manufacturers—and particularly General Motors—are another group of companies which is bound to profit from the concentration on urban and suburban traffic problems.

Says Lowell K. Bridwell, deputy to Transportation Chief Boyd: "Bus transportation, using existing highway rights of way and even some railroads right of way, is going to come on strong in the form of 'bus trains' using specially designed rights of way as 'tracks'."

According to John C. Kohl, transportation adviser to Robert C. Weaver, head of the Housing & Home Finance Agency, the "busway" idea for transit could get an experimental start in the final construction work on Interstate Highway 95, which will run into Washington, D. C. The highway, called by Washingtonians the "Shirley Highway," will have two center lanes between the regular auto lanes. In the morning, the center lanes could be used by buses for traffic going downtown. In the evening, they will be used mainly by buses going out to the suburbs. Express buses will have their own ramps and a station in Washington connected with the city's planned $450-million subway system.

Kohl says the Housing & Home Finance Agency is studying the possibility of using old railroad and trolley rights of way in New Jersey and Atlanta, Ga. as "busways." In addition, Minneapolis is studying the idea. "We might build asphalt concrete runways for tires alongside the tracks," says Kohl. He claims the buses and trains wouldn't interfere with each other because they could be guided by automatic switches and signals. "The buses in some areas will have a flexibility in collecting and dispersing passengers that a train doesn't have," he says. A bus, he explains, can use the railroad right of way to a given suburb, then leave the busway by a ramp and run into the local street system.

General Motors has conducted a series of tests at its proving ground to determine how efficiently buses can be operated if they are run on exclusive lanes. GM reports that it's possible for a lane to carry 1,200 buses an hour traveling at a speed of 55 miles an hour. Since each bus carries approximately 50 passengers, 1,200 buses could provide transportation for 60,000 people an hour.

Slot-Machine Autos

Transportation experts believe the problem of getting around the cities and the suburbs will create a boom in the car-rental business. This business already is expanding at the rate of nearly 20% a year, but the experts believe it's bound to grow even more rapidly in the future.

Brookings Institution highway expert Edwin T. Haefele says: "You don't take a phone booth around with you downtown just because you want to make phone calls during the day. The use of the coin-or-token-operated town vehicle is bound to come." Other experts believe this will be a great opportunity for owners of choice parking areas to move into the car-rental business.

At Chrysler, Harry E. Chesebrough, vice president in charge of product planning and development, believes the rental cars of the future may be electrically powered, and he foresees the day when they will be "parked in a lot and nuzzled up to a post topped with a device something like a parking meter. The vehicle is getting its batteries charged and it is locked to the post until released in some way . . . You insert your credit card in the box (releasing the vehicle, unlocking the doors and activating the power system) . . . You complete your mission, find another unused parking lot, drive into the post to hook up and lock the vehicle, insert your credit card . . . and walk away."

Obviously, there still will be work for everybody in the highway industry even after the Interstate Highway Program is completed. The problem for the companies now profiting in the industry will be to adjust themselves to new engineering problems and new opportunities. As Ed Rainey of S. J. Groves says, "I know some in the industry don't like the change coming. It's more agreeable to work out in the country . . ."

Agreeable or not, the trend is changing. There will still be big money to be made in highways and on the machinery to build them and the autos to run them, but only by those outfits—from sign painters to computer makers — that start preparing now for the shifts that are clearly in the making.

—END

highway BOOM

This picture sequence was taken ot Wolf Creek in conjunction with Interstote 15 construction this spring. The blast, set by Ray Johnson, wos several tons in strength. Johnson used ammonium nitrate prills to loosen earth for roadwoy construction, and the photos dramatically illustrote the power and effect of blosting.

DEFE
DRI

The Montana Highway Department has in progress a course designed to improve your driving habits as an employee of the Commission. From early spring until late this fall, Safety Department personnel will be traveling throughout the state presenting the driver improvement course to highway workers in all divisions and districts.

This program was initiated by the Highway Department in conjunction with the Governor's plea for driver safety instruction for all state employees. Clint Fulkerson, director of the Highway Safety Department, and three Safety personnel are qualified instructors for the course sponsored by the National Safety Council.

With more than 100 days of classes ahead of them in the instruction of 2,300 highway workers, the instructors began in the spring with the department heads in the Helena office. During the next weeks every employee in the headquarters took the eight-hour course. While two instructors taught in the Helena office, the other two hit the road to begin the job of reaching workers in the other districts and divisions. By August more than 1,500 employees had completed the course.

If you haven't already taken the driver improvement course, here is what you will be

Department heads of the Montana Highway Commission were among the first to receive the defensive driving course. Here the department heads turned students for the day, listen intently to the instructor.

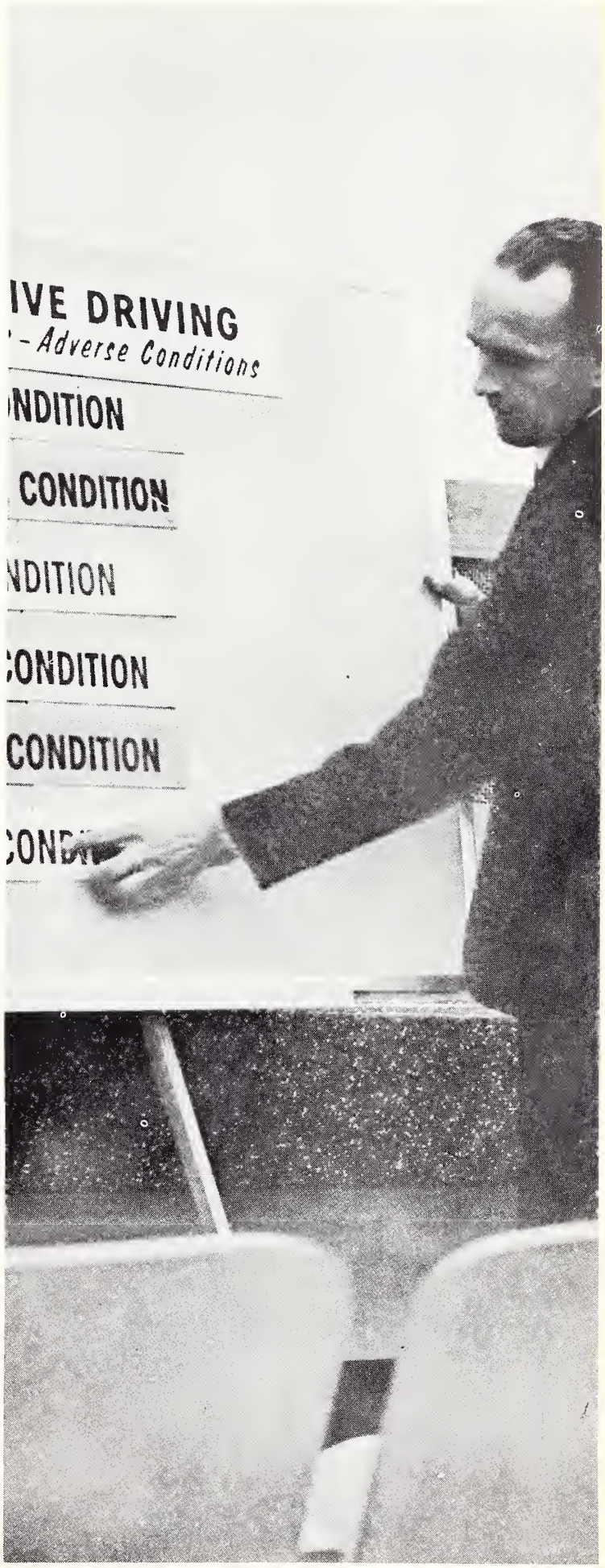
NSIVE VING

exposed to sometime in the next few months. The course takes a full work day and includes seven films enriched by comments from the instructor. The course is not painful—in fact, it is interesting and very informative. Between films and instruction, the various sessions are complemented by class comments and questions.

Each class attendant is given an instruction booklet with a brief outline of the course. Lots of space is provided to allow for note-taking during the sessions. You will also get several pamphlets with illustrations and informaiton recapping the course sessions. The major "textbook" is the State of Montana Driver's Manual.

Those of you who have driven everything from cars to snow plows might feel that you have nothing left to learn. But this course was never intended to teach you or anyone else **how** to drive, but rather how **not** to drive. In other words, the course is designed specifically to show you how to spot an accident and instruct you in avoiding that accident—whether it threatens from the front, rear or side.

Taking this safety course is well worth the time each highway worker will spend on it. Possibly worth a lifetime.—END



Vern Gray, part of the Safety Department of the Highway, points to visual aids while instructing the defensive driving course. Vern is presently traveling throughout the state giving the program to all highway employees.

Hydroseeding, o process now under research, is a form of hydraulic seeding. Mulches made of a combination of straw ond asphalt are sprayed onto the roadsides by pressure from o hydrogun. Seeds safely embedded in the mulch are held securely to the ground and given a chance to germinote and survive. This hydroseeder deposits mulch and grass seed along roadsides near Townsend. The process is part of an experiment being conducted by Montana State University at Bozeman.

Highway Revegetation

"There are times when you want to throw up your hands and quit! But then you carefully scan a patch of hillside and detect some green showing up. Then all seems better."

Richard L. Hodder, Supervisor of Highway Revegetation Research as well as assistant professor of Range Management at Montana State University at Bozeman, faces no small problem in his work. Growing grass or any vegetation on the slopes alongside Montana highways is a tremendous problem indeed. Many factors work against even the highly trained agronomist—he is faced with steep slopes, high winds, little moisture, severe heat and cold, and poor soil conditions.

Hodder sports a healthy suntan, and his everyday attire is range boots, jeans, and a work shirt. He started this study of various methods of revegetating roadsides back in May of 1964. Armed with very little equipment and lots of experience in range management, Hodder headed for the slopes near Highway 12 east of Townsend.

"Townsend represents a general condition

that dominates many areas of Montana. We have desert-like conditions there—very little precipitation, a variety of different soil conditions, and a rip-roaring wind that blows from all directions. And this is not to mention cows grazing through the experimental plots," Hodder explains.

The Townsend experiment site is east of town and runs along Highway 12 for some five miles. To the untrained eye, barren slopes appear most commonly. But a variety of mulches including hay or straw covers much of the ground, and regardless of how it looks, that means progress is being made.

Mulching with straw, hay, wood pulp, excelsior, latexes, plastics or asphalts is only a small part of the process Hodder is working to perfect. Hydroseeding is a term many people use to describe the hydraulic seeding process, but few fully realize that the actual hydroseeding is the simplest part of the job.

"We have a sequence of events we follow on every attempt at seeding," Hodder explains. "Preparation of the seedbed, observation of weather conditions and the time of year, choice of seed and mulch are considered. We alter these things from time to time and observe the results. Sometimes we win, other times we lose. But it must be said that we win more than some would like to believe."

In the hydroseeding process, proper seedbed preparation is critical, according to Hodder. "Without it our entire project could slide down the mountain."

After the determination of soil condition in a given area, the proper seed is selected. Then men and machines move onto the sloped hillsides adjacent to the highway. A tractor pulls a heavy logging chain, specially adapted with sharp spine attachments, back and forth across the slopes. This action eliminates gullies, loosens the soil, jars loose large rocks and prepares the slope to receive the seed.

Then mulching may be done. If so, the type of mulch as well as method for application must be determined. Through experimentation is gained the knowledge of whether to stubble in the mulch or blow it on under pressure.

"Straw or hay mulch is sometimes punched into the ground by a special disc plow," states Hodder. "We have found that when native hay is used for the mulch, it contains a certain amount of wild seed. This seed sometimes takes hold and within three months we have

Preparation of the seedbed before hydroseeding is critical. Here a heavy logging chain, specially adapted with sharp spines, is pulled back and forth across the roadsides to eliminate gullies and loosen the soil.

Mulching with straw, latexes, wood pulps, and asphalts is an important part of the hydroseeding process. This close-up shows a straw and asphalt mulch prepared for application. The binding properties of the asphalt hold the mixture together, giving the seedlings a firm basis for growth.

a strand of grass. It wasn't planned that way, but it does work."

Punching the mulch into the ground affords protection from gully washing. Each furrow of mulch acts like a dam to stop the rampage effect of water. Case histories indicate that many projects might have been washed out if this mulching technique had not been used.

Other types of mulches have been sprayed on by pressure from the hydro-gun. Mulch is mixed with water or asphalt and blown onto the hillside. The use of asphalt with straw and hay forms a binder to hold the material together. Wood fiber products have also been used as mulch, and their binding properties hold them together well. Recently, a powdered plastic mulch has been tried. When mixed with water the powder expands many times in volume and weight.

This newest technique seems to be more controllable in application than the others. "This is new, of course," Hodder says, "but the cost is low and the benefits are high. We might have something here."

Under the mulch application, the hidden action accelerates each day. Shoots of life begin to sprout through the hay and color comes onto the hillsides. So what looks like bare hillsides covered with straw does indeed mean that progress is being made.

Montana's entrance into the roadside seeding business originally started with the intention of developing application equipment. Hodder notes, "But in order for us to make the proper equipment, we had to first determine the biological requirements. It just isn't good business to develop equipment to apply seed and mulch if the seed can't take. So we reversed the procedure and now instead of developing equipment first, we put to work the various techniques needed for germination of the seed, as well as survival of the seedling."

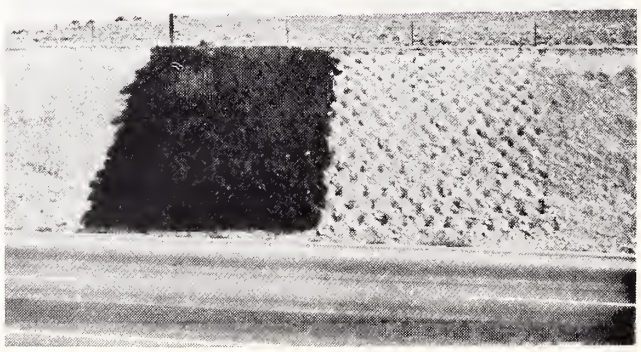
Hodder works the project alone, with the exception of summer months. Then he is assisted by maintenance personnel from the Montana Highway Department. Or, sometimes, he is assisted by an undergraduate student from the University.

How does Hodder feel about the project—and its success?

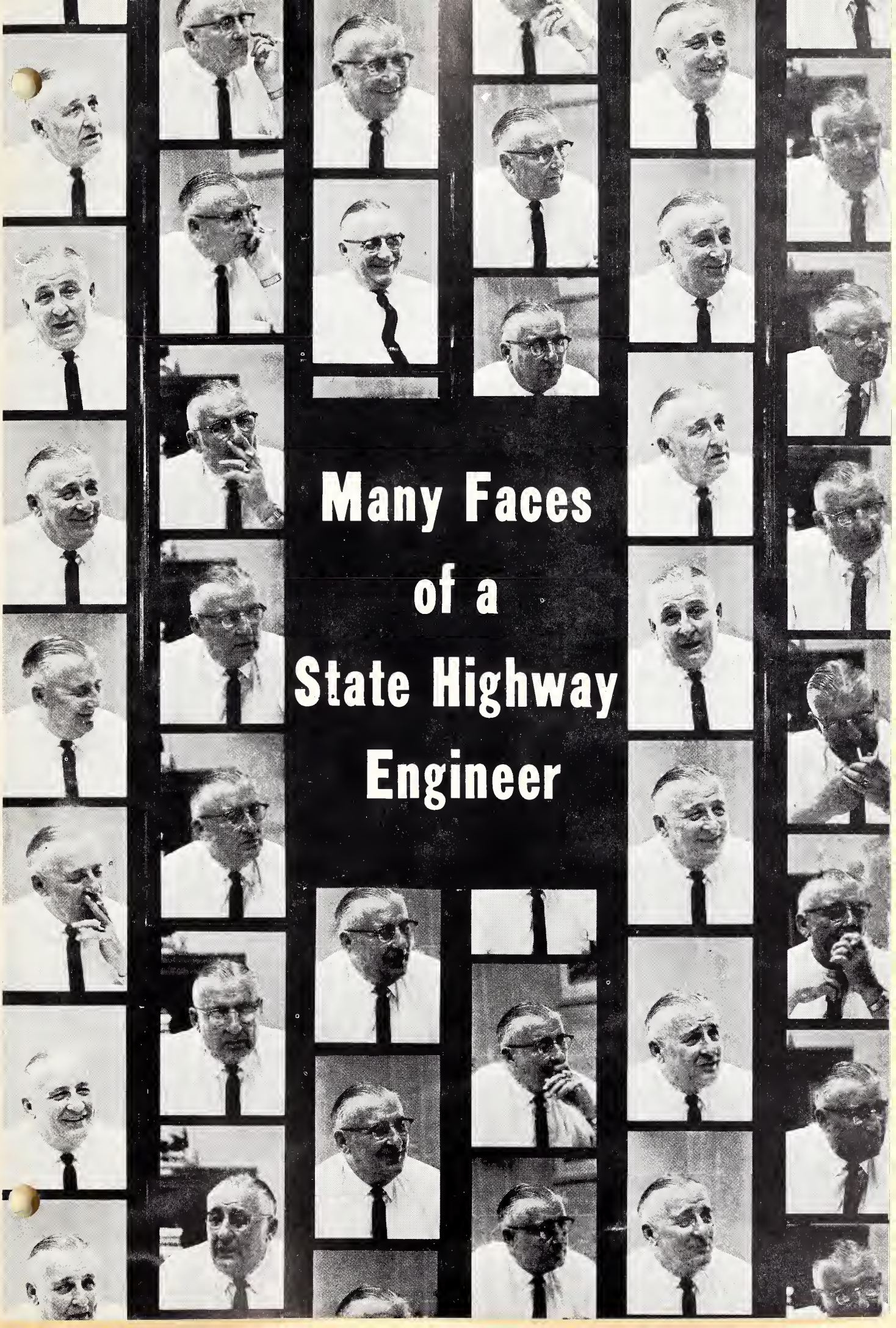
"It is just like other challenges that one works on day in and day out. I know someday we will break through the barriers that today seem mammoth. When we do, I will feel that we have accomplished a great deal," Hodder asserts optimistically. "But until we do, it's hard, discouraging work. And the job of convincing people that even though the first look at the hillside doesn't show much, underneath the mulch life is going on. We will continue to work at this. And we are winning the battle of vegetation on Montana highway slopes."

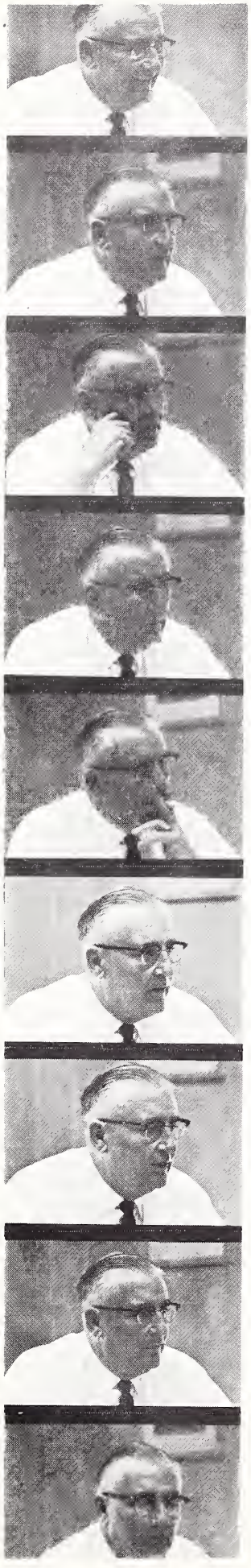
To sum it up, one might say hydroseeding, when applied in conjunction with sound range management principles, can provide uniform stands of acceptable grass on roadsides at a reasonably low cost.

That is the job Richard Hodder works at today.—END



These pitted areas indicate the use of hydraseeding. The hay, seed, and asphalt mulch has been punched into the ground ta affard pratection fram gully washing.


Many Faces
of a
State Highway
Engineer



He has to be a little bit of everything. He has to know how bridges are built, he has to know every minute detail of highway construction, he has to direct and manage the spending of $90.5 million dollars. In short, he has to know more than a little about a lot.

He is Montana's State Highway Engineer, Paul M. Johnson. And in his position, Mr. Johnson puts on many faces—sometimes all in a single day's work. The State Highway Engineer job entails many facets, and Mr. Johnson has to be versatile enough to turn a new face to each challenge.

Engineer—Initially, the State Highway Engineer has to be familiar with all phases of engineering. In this particular phase of his position Mr. Johnson comes well equipped. He has been with the Montana Highway Commission since 1932, when he started work in the bridge section. He spent several years in the field on construction projects, until his promotion to District Engineer of the Billings District. In the spring of 1964, Mr. Johnson was transferred to Helena headquarters as the State Highway Engineer.

He holds a B.S. in Civil Engineering from the State University at Bozeman, and is a registered Civil Engineer in the state. He is a fellow of the American Society of Civil Engineers and the National Society of Professional Engineers.

With more than 25 years of experience in highway engineering, Paul Johnson has a full reserve to draw from when he turns the face of an engineer. And he has to draw frequently from his experience to make the many decisions required of him. In his work with the Commission and in conjunction with the various departments making up the Commission, Mr. Johnson must have a working knowledge of each minute phase of highway construction.

Public Relations Man—One of the most time-consuming faces Mr. Johnson has to assume is that of fulfilling the many duties incumbent with holding a title. He answers the many letters that come into the Highway Department each day—some complimenting, some making requests, and some complaining. His correspondence reaches every corner of the state because he takes very seriously his responsibility in personally answering his correspondence.

In the same respect, Mr. Johnson acts as a "buffer" between the Commission and the public. Delegations planning to present a case before the monthly meeting of the Commission members often meet first with the State Highway Engineer. After he has worked out the many details, Mr. Johnson arranges for the delegation to appear before the Commission.

In addition, whenever and wherever he travels, Paul Johnson acts as a representative of the State of Montana, and Montana highways. Here, to the highest degree, he must assume the position of a real public relations man—selling his state as a product to tourists, businessmen, and future engineers.

Speaker—As State Highway Engineer, Mr. Johnson is called upon to give some speeches before service clubs and other similar groups. He also often speaks a few words at highway dedication ceremonies, but the majority of his serious "'speaking" takes place within his office in Helena, which is often

besieged with visitors and phone calls.

Traveler—Mr. Johnson's position requires frequent travel, both in state and out of state. Within the state he is on the move to view problems or solve them. He often meets delegations on their home grounds and personally studies their requests. He meets with the various Chambers of Commerce to discuss the promotion of highways in the state.

In connection with his travels in the state he familiarizes himself with the many construction projects on Montana highways, along with any safety hazard spots or areas often under complaint.

His out of state travel is usually in conjunction with the American Society of State Highway Officials, the Western Society of State Highway Officials, and the Council of Interstate Government.

Businessman—Mr. Johnson is obviously a businessman. At present, he is the administrative head of a $90.5 million-dollar business.

Financier—It is the responsibility of the State Highway Engineer to see that highway funds are used to the best degree and to the maximum benefit. He works closely with the federal government on the allocation of funds, and within the department he does considerable budget work. Each fiscal year many department heads submit budgets for the coming months. This fiscal budget is reviewed by Mr. Johnson, and after consideration, and sometimes changes, he approves the budget and presents it to the Commission for final approval.

It is this face of the financier that Mr. Johnson found the most difficult to assume. "Despite more than 20 years of experience in the field, I was never closely associated with the financial end of highway work," the State Highway Engineer explains. "Certain percentages of state and federal funds are allocated for interstate, primary, secondary and urban highways, and all of this presents a pretty confusing picture for the new State Highway Engineer."

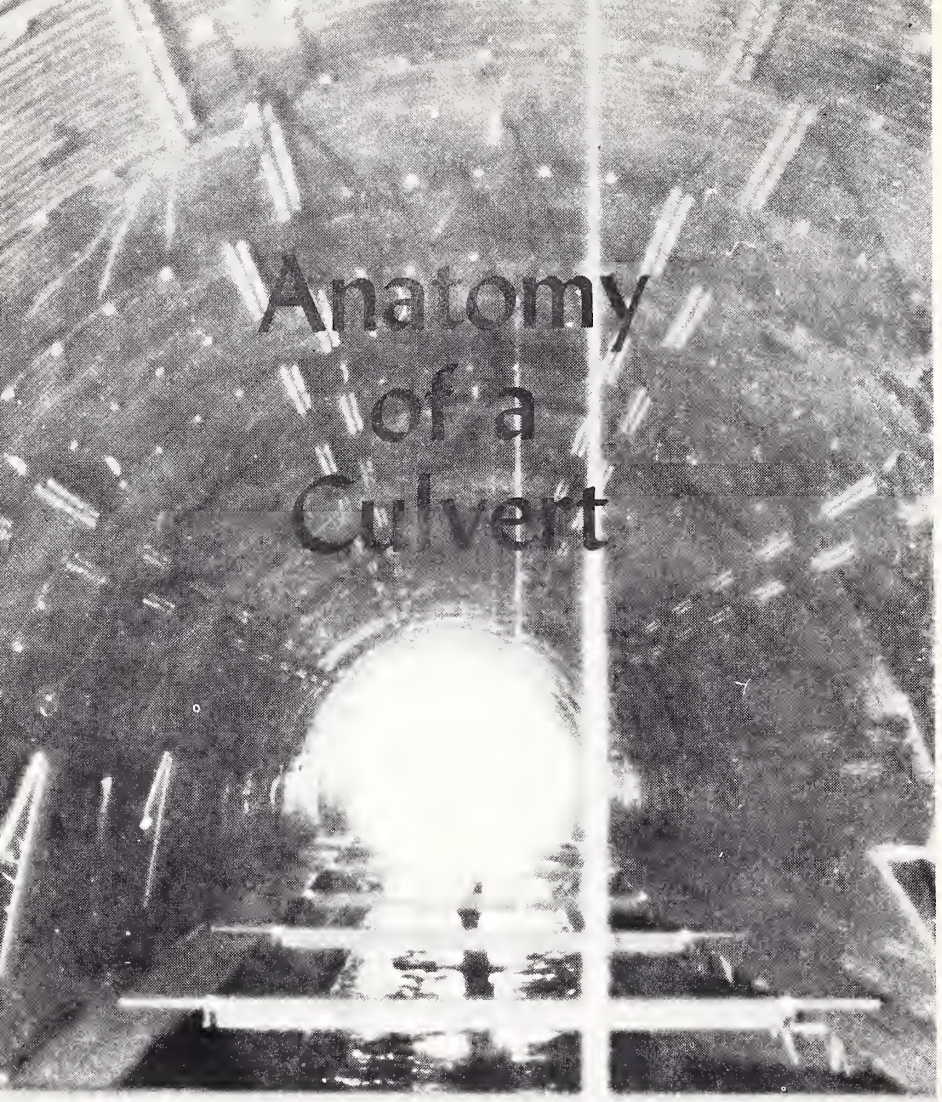
Administrator — As administrative head for more than 2,500 employees, Paul Johnson carries a heavy load of responsibilities on his shoulders. He calls weekly staff meetings of the department heads for the purpose of discussing policies and problems.

Consultant—Mr. Johnson works in close consultation and cooperation with the Bureau of Public Roads on construction and finance of Montana highways. He also works with the BPR on beautification in that he knows how much money the Montana Highway Commission has for highway beautification, and where that money should be spent for the best advantage of the whole state.

He also works in cooperation on many projects with the various other state departments.

Decision-Maker. — "At times the whole job seems to be made up of decisions," Mr. Johnson says. And he does indeed make many decisions. Every face he assumes as State Highway Engineer requires a decision at some time—some easy, and some not so easy. But when he accepted his position as State Highway Engineer, Paul Johnson also accepted a variety of new challenges. Time has made him like a chameleon, and his versatility and experience allow him to make frequent use of the many faces of a State Highway Engineer.

Anatomy of a Culvert



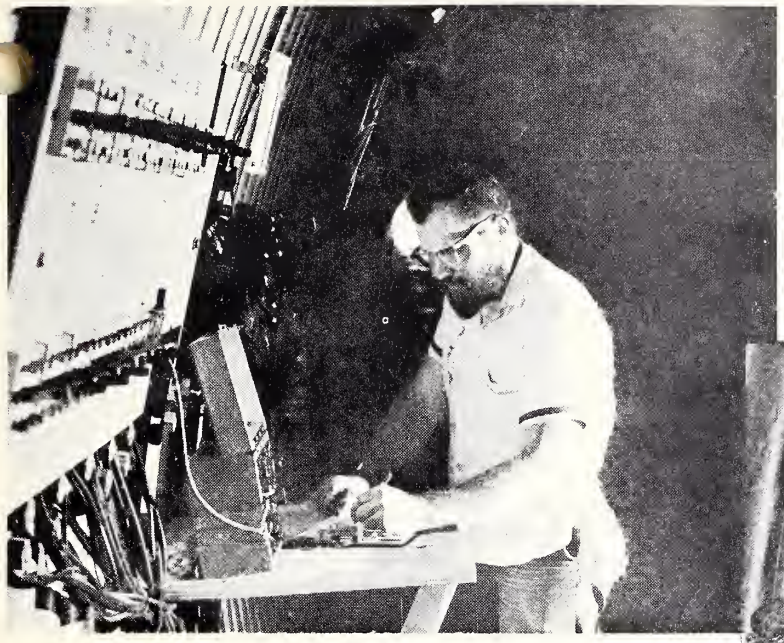
One of the largest culverts in the United States has been successfully installed at the southern entrance to Wolf Creek Canyon in Central Montana. The culvert, 18.5 feet in diameter and 508 feet long, carries Prickly Pear Creek under an 84-foot depth of fill, while Interstate 15 runs over the fill.

It is this fill which makes the culvert unique. The funnel is the largest of its kind west of the Mississippi to have such a deep fill overhead, and it was fill which caused the collapse of the original Prickly Pear culvert in June, 1965. In order to avoid a repeat performance, the Department of Civil Engineering at Montana State University at Bozeman has undertaken research to study the effects of this fill on the replacement culvert, completed in December, 1965.

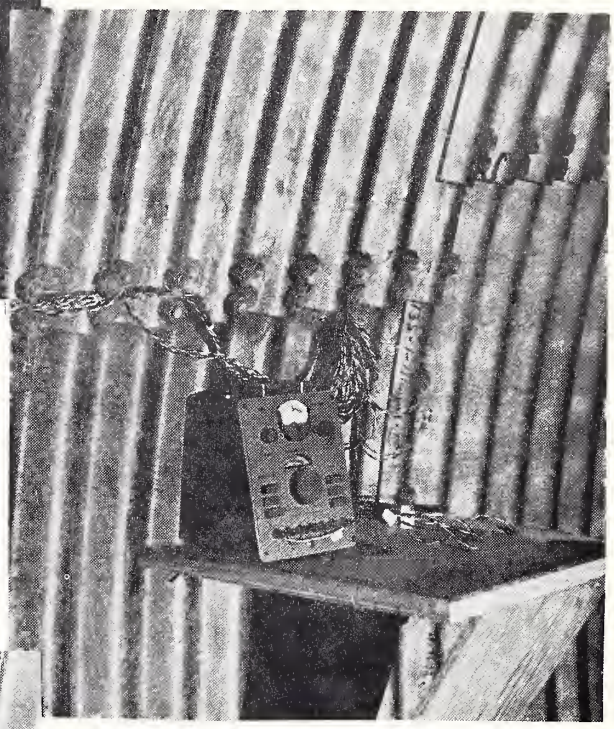
The State University Engineering Department, under the direction of Alfred C. Sheer, has devised numerous gages to give constant stress or strain readings in the culvert.

Down in the culvert, soil stress meters show the earth pressure acting on the funnel at the points where the meters are mounted. Strains in the culvert plates are measured with small gages glued to the plates and covered with epoxy and rubber waterproofing layers. Six ordinary rubber hot water bottles, full of water, are buried in the fill and are connected to direct reading gages. These gages indicate the pressure which the earth exerts on the buried hot water bottles.

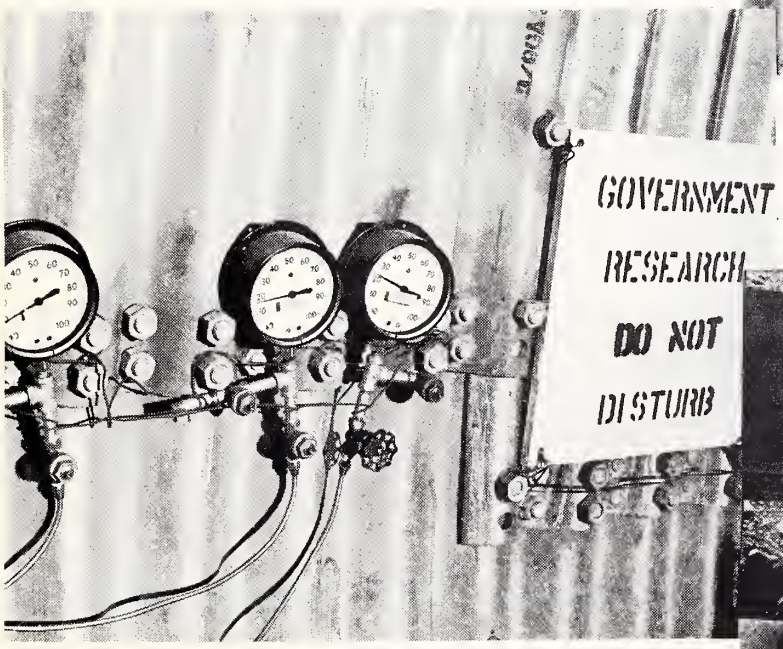
Professor Sheer reports that this instrumentation shows that the earth pressure acting on the culvert is not particularly high, in spite of the deep fill. Stresses in the culvert wall are also small and there has been very little distortion or movement of the culvert so far.



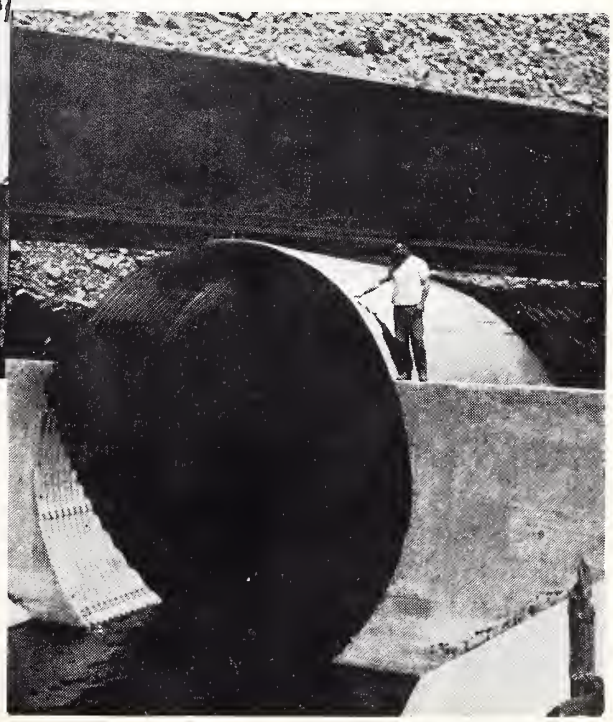
Professor Sheer takes notes from soil stress meters in the culvert. The board with the throw switches is connected to 30 soil stress meters, most of which are mounted flat against the culvert wall on the outside. Each of these meters registers the earth pressure acting against it, which leads to the determination of the pressure on the entire culvert.



Strains in the culvert plates are measured with small gages glued to the plates and covered with epoxy and rubber waterproofing layers. These are connected to a strain indicator which here measures the stresses and strains in the culvert walls.



Ordinary hot water bottles, full of water, are buried in the fill above the culvert. Each bottle is connected to these direct reading pressure gages which indicate the pressure which the earth exerts on the buried hot water bottle.



Professor Sheer is dwarfed beside the mammouth culvert which Montana State University is using for the study pictured above. This is the largest funnel of its kind west of the Mississippi to have such a deep fill overhead.

"Good Morning!

May I Help You?"

"Dear Highway Hostess,

The most interesting and pleasant part of my vacation was my stop at the Information Center in Helena. I enjoyed very much talking to you and want to thank you for all the information you gave me. I will be looking forward to returning next year so I can see and talk to you again.

Sincerely,
Vic E. Gregory
Glenwood Springs, Colorado"

This is just one of the many letters coming daily into the Montana Highway Departme The letters come from tourists who have taken

part in a program of hospitality just two years old. The program begins with a sign outside the Helena headquarters which advises strangers that highway and tourist information is available inside, and it continues with a friendly smile and greeting from the Montana Highway Hostess.

This year's hostess, Bonnie Jo Robbins, is a former Miss Montana Centennial and no stranger to hospitality. Last year's hostess, Karen Munson, is employed as a secretary in the Public Information Office and is on ready call if she is needed at the tourist information desk.

The Highway Hostess is well-equipped with every piece of information available about Montana, and she has plenty of pamphlets from the surrounding states. In addition, she has available for distribution maps of nearly every state in the Union.

More than 2,000 visitors stopped in at the booth last summer, and figures this year are even higher. Tourists have come from as far away as New Zealand and Ireland, and from as close as Helena itself. Many Montana na-

(continued)

Last year's Highway Hostess, Karen Munson, directs three out-of-state tourists through Montana. The Information desk at the Highway Department in Helena is fortified with maps from most of the states, along with many pamphlets giving detailed information about various tourist attractions in Montana. The Hostess helps tourists plan a route through the Big Sky Country, as well as giving them tips on what to see and do.

tives stop in for directions and tips on what to see and do in our huge state.

When the Highway Department's hostess is not helping tourists, she writes letters to those who have signed her guest book when they stopped to see her. She asks them how they enjoyed their stay in Montana, and extends to them an invitation to return to the Big Sky Country. Most of them reply.

Generally they express astonishment at receiving a letter from her:

"We were really surprised to hear from you. We have stopped at quite a few information booths in different cities and states, but this is the first time we have ever heard from one. We think it is a very good idea."

Most of them express appreciation for the Hostess' aid:

"Nothing you could have done could have made our wonderful trip to Montana any more enjoyable; however, we thank you for all the information your office sent to us ahead of time. Because of it, we were able to visit five ghost towns we didn't know about before, and these were highlights of our trip."

And from another:

"Many thanks for your generous and enlightening packet of information on the great State of Montana and your bordering territory. You are a cooperative and gracious representative of your state."

From Idaho came a suggestion:

"We have one suggestion we would like to make, not only for Montana, but for all states. We think there should be more camping and picnic grounds for the travelers. So far we think Oregon has the nicest."

And from Illinois came a compliment:

"I would like to say that your highways and lakes and dams were the cleanest that I have ever seen. You don't see trash or anything thrown out there along the highways like you do in a host of states. Illinois is very bad about this. Clean highways and towns are very nice. I wish our state department could visit your state. Maybe they could learn something."

And from people interested in mines and ghost towns:

"Most of our time was spent looking for Lump Gulch and going through the mines between Clancy and Jefferson City. The most interesting ghost town we visited was Granite and the Cable Mine. The most interest area, we thought, was around Anaconda and Philipsburg. We may make another trip to this area later this year."

And from an engineer:

"The Civil Engineer in me demanded that I visit the Hungry Horse Dam and later we went south to Missoula to take U. S. 12 through Lolo Park and parallel the Lewis and Clark Trail through Idaho and on to Washington."

And from avid fishermen:

"The weather in your state was ideal and we did some fishing, but not nearly enough to please my husband—what with all the nice lakes and streams and the Missouri River. We hope to spend another vacation up at Flathead Lake where the fishing seems to be excellent. We thoroughly enjoyed the mountain passes and the lovely picnic areas."

From a Pennsylvania college teacher came this comment:

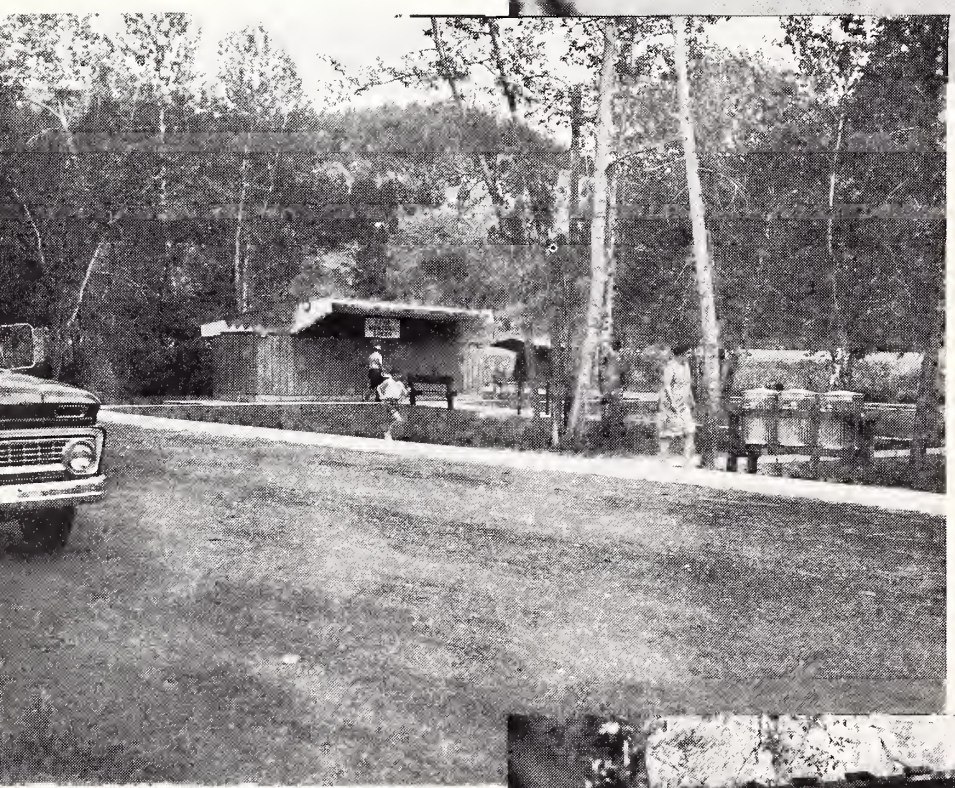
"I should also like to say that the State Museum was the best part of our trip. The displays are comparable to those of the Museum of Natural Science in Philadelphia."

And from a former Montanan came the wish to return:

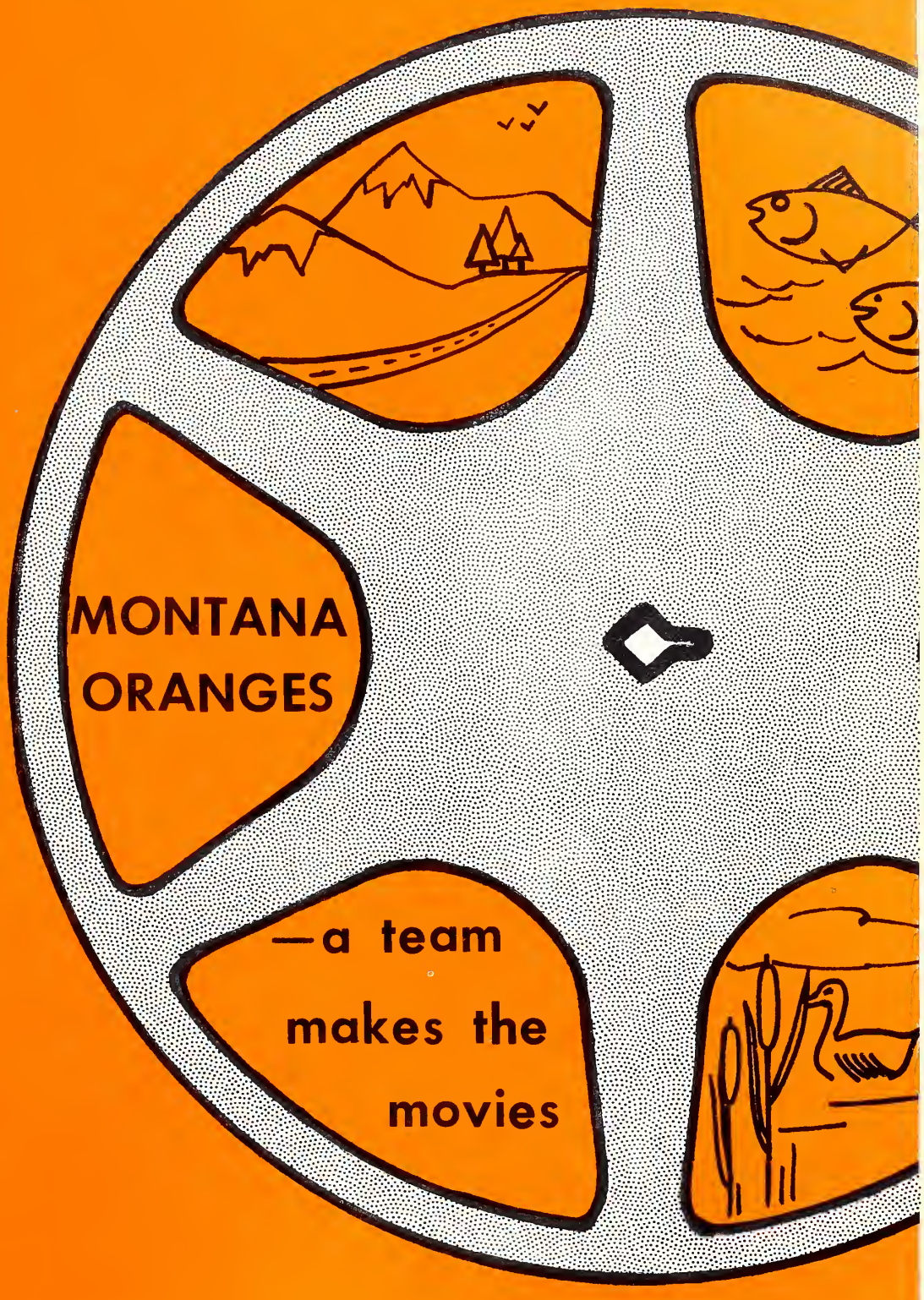
"We have lived in Montana, and would like to live there again at some future time. Meanwhile, we continue to be avid Montana boosters. We taped our VISIT MONTANA poster to the back of our travel trailer for all to see during our 2,500-mile trip through four western states and Canada. So your advertising was well displayed."

From all of the replies received at the information desk came compliments on the hospitality program and thanks for the gracious aid given them. Everyone seems to be very impressed with the friendliness shown them in Montana, and many indicated plans to return to the state for their vacations next year. And the Montana Highway Department Hostess seems to have played an important part in the favorable impression our state has imparted to the traveling tourist.—END

Montana's Rest Area Story



KEEP
MONTANA
GREEN


MONTANA
ORANGES
—a team
makes the
movies

"700,000 Montanans rely
upon the Montana Oranges.

Yes, the people rely.

Men late to work.
Children riding to school.
Ladies bustling to tea.
Tourists coming to see.

Grandsons to Grandma's
Campers to Glacier.
Rockhounds to the rocks.
Teenagers to bops.

Lumberjacks out of the hills
with lumber for the mills.
Copper out of the ground.
Lead, zinc, silver to be found.

Wool to Washington.
Wheat to Wichita.
Black Angus to Buffalo.
Sugar to St. Louis, Mo."

Yes, many people rely on the Montana Oranges—a team of men, women, and hundreds of orange vehicles working in conjunction to design, construct and maintain thousands of miles of roads. And these Montana Oranges are fea-

tured for the first time as a team in one of the Highway Department's newest venture—the production of a 30-minute, full color, sound film.

The film, initially designed for a premier showing at the World Meeting on Roads in London this September, will be carried to England by State Highway Engineer Paul Johnson. Production of the film began more than eight months ago when the Commission engaged the professional services of the Film and Television Department of the State University at Bozeman. The department, under the direction of Professor Fred Gerber, began work on the movie in cooperation with the Highway Department's Information Division in Helena.

Jim Kelly, instructor in the University's Film and Television Department, started shooting film footage in January. In the following months he covered every type of terrain in Montana—from the flatlands in the east to the cold, mountainous regions in the western part of the state. He captured on film the highways and phases of highway construction and maintenance in nearly every part of Montana.

Kelly, at first working with former Highway photographer Chet Dreher, covered everything from interstate shots to bear jams in Yellowstone Park, from snow plows to paving machines. He filmed construction sites, rest areas, maintenance crews, graders, striping machines, sanders, bridges, and every season of Montana weather.

Travel to the many areas of the state was done primarily by automobile, but actual filming operations were conducted from airplanes,

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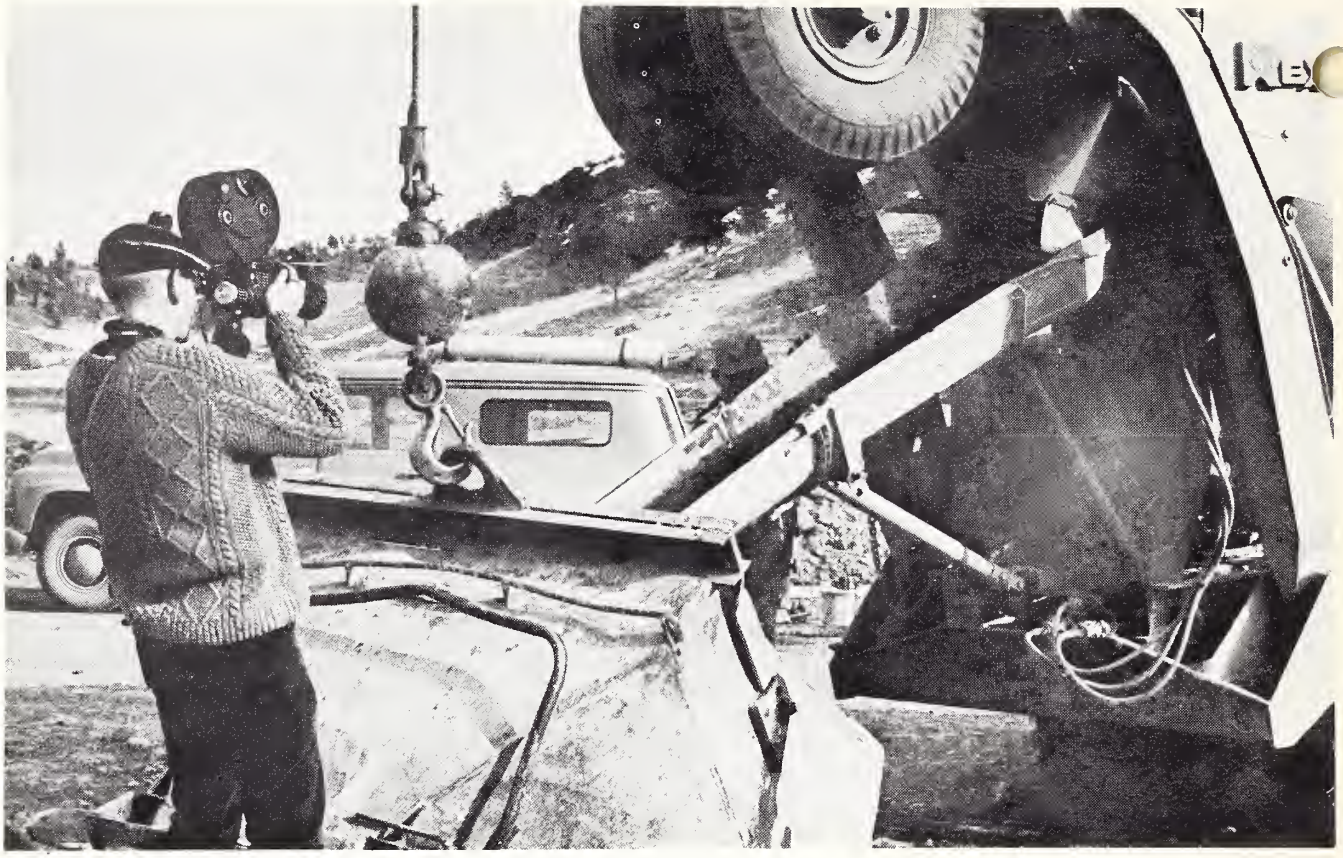

helicopters, and trucks. Actual equipment sounds were recorded along with the filming to lend authenticity to the finished movie.

Since the film covers every phase of highway construction, the photographers worked in close association with the many departments of the Highway Commission. Weather patterns were plotted for the filming of blizzard scenes or winter maintenance shots. Travel was paced with weather conditions and construction operations. All divisions reported the locations of any unusual equipment in use and kept Kelly informed about construction projects.

Sandwiching more than a year's work into the months between January and July, Kelly traveled hard and shot thousands of feet of film.

Kelly's work on this film follows a long background in filming and television. He was graduated from the State University at Bozeman in 1959 with a B.S. in Film and Television, and within another three years he had added an M.S. in Audio-Visual Communications from Indiana University. He established the first motion picture department at the Cummins Engine Company, Indiana, and then spent a year traveling throughout Europe. In 1965 he accepted the position of instructor at Bozeman.

Kelly has directed and produced more than 100 motion pictures in connection with the U. S. Air Force, Indiana University, Cummins Engine Company, and Montana State University.

Kelly hopes to enter "Montana Oranges" in next year's University Film Producers Association Film Festival.—END

Highway MAIL BAG

Dear Sir:

I wish to bring to your attention the courteous assistance rendered to me and my family by one of your employees on our recent visit to your state.

I had the unfortunate luck to have two flat tires somewhere between Philipsburg and Anaconda. This left us stranded in unfamiliar territory, and unable to continue to a place to have the tires repaired.

Mr. Bill Westerlund of Anaconda stopped to assist us. Even though anxious to get back home and traveling during his own leisure time, he gave me a ride several miles back to Philipsburg. In addition, he waited for me to have a tire repaired and then returned me to my car. Mr. Westerlund's courtesy was a bright spot in an otherwise dismal situation, and I believe that you should be aware of his willingness to assist someone in distress.

You have a very beautiful state, and aside from the tire trouble, we had a most enjoyable vacation traveling through Montana.

Yours very truly,
Garnet B. Blohn
Sioux City, Iowa

GOOD WORK

congratulate you on the "best yet" in your better and better Center Line. This last issue was exceptionally good—interesting layouts, good writing, and meaty subjects. And that picture on page 19 was a dilly!

Keep up the good work. You're doing well by the Big Sky Country.

W. R. Nunn
Assistant Public Information Director
Missouri State Highway Commission

THANKS FROM HIGH SCHOOL TEACHER

Dear Sir:

I would like to take this opportunity to thank you and our staff for the recent tour my Civics class from Helena High School took through the Highway Commission offices.

Your staff was most courteous and friendly in showing the group how the Commission functions. All of us gained from the tour and it greatly helped our study of State Government.

Again, thank you.

Sincerely,
Mrs. Penelope Egan

THANKS FROM SIXTH GRADE STUDENTS

taking our room and Mr. Hartman's through the Highway Building. I think the Xerox machine was very interesting and I bet it saves a lot of time. I also enjoyed going through the printing room, the photo developing room, the radio room, the IBM department, and I especially liked the microfilm developer.

Marcia Hansen
Helena Schoolgirl

A LITTLE PRAISE

Dear Mr. Johnson:

You people, like County Commissioners, get a lot of criticism and very little praise.

We Commissioners would like to take this opportunity to thank you for the speedy job programming and letting for bid project S-362 Colstrip-South.

We also appreciate the excellent cooperation we have received from Mr. Fred Wells, Mr. W. K. Brittain, and Mr. John VanVynch. These people have gone out of their way to be helpful. They have provided invaluable advice and assistance in our many problems, especially road problems on Secondary 315.

Very truly yours,